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File Code: 3413 **Date:** February 10, 2015

Subject: Eastface Insect and Disease Evaluation

To: District Ranger, La Grande Ranger District, Wallowa-Whitman National Forest

On September 25, 2014 we were on the District with Bob Clements to review insect and disease conditions and trends in the East Face restoration area. We were asked to provide input on the insect and disease risks to these stands, how treatment might affect these risks, and what could be expected if no treatment occurred.

This area covers approximately 40,000 acres southeast of Ladd Canyon road (Fig. 1). It extends from the Forest border at Ladd Canyon and runs to the southwest, bordered by Ladd Canyon road, to the 73 road on the south. The 43 road generally follows the ridge dividing the Grande Ronde drainage from the Powder River drainage and forms the dividing line between the Whitman Ranger District and the La Grande RD. As the name implies, this area drains the northeastern part of the Elkhorn mountain range. Elevations range from about 7500' near the Elkhorns to about 4800' on the eastern edge of the area. The area is cut by many creeks generally flowing northeast or southeast, creating south- and north-facing slopes. The northern part of the area is dominated by moist upland forests, the southern area by cold upland forests, and the eastern, lower elevation areas by dry upland forests. We visited four stands along the 43 road chosen to represent some of the variety of the area proposed for management.

The project area has a much higher proportion of late seral species dominance than was historically present. Currently, of the approximately 17,000 acres of moist upland forest in this project area, 12,000 acres, or 70%, are dominated by grand fir. Historically this figure would have been in the 15-30% range (Powell 2014), or up to about 5100 acres. So current grand fir dominated sites are estimated to be at least twice those present historically.

Stand 1076, 45.1416°, 118.06667°, about 5000' elevation, northeastern part of the project area

This is a cool-moist ABGR/LIBO3, grand fir/twinflower potential vegetation type that had a partial harvest about 30-40 years ago. The ash cap here has been compacted and rutted in areas. The mixed conifer overstory includes western larch and Douglas-fir with dwarf mistletoe, lodgepole pine, grand fir, Engelmann spruce, and a few ponderosa pines. This stand has moved from dominance by early seral larch and pine to dominance by late seral fir and spruce.

Sites dominated by late seral species are more susceptible to defoliators and root diseases. True firs and Douglas-fir are the preferred hosts of Douglas-fir tussock moth (*Orgyia* *pseudotsugata*), while western spruce budworm (*Choristoneura freemani*) also readily feeds on Engelmann spruce and western larch. Grand fir and/or white fir are highly susceptible to two of the most damaging root diseases in the Blue Mountains, Armillaria and Annosus.

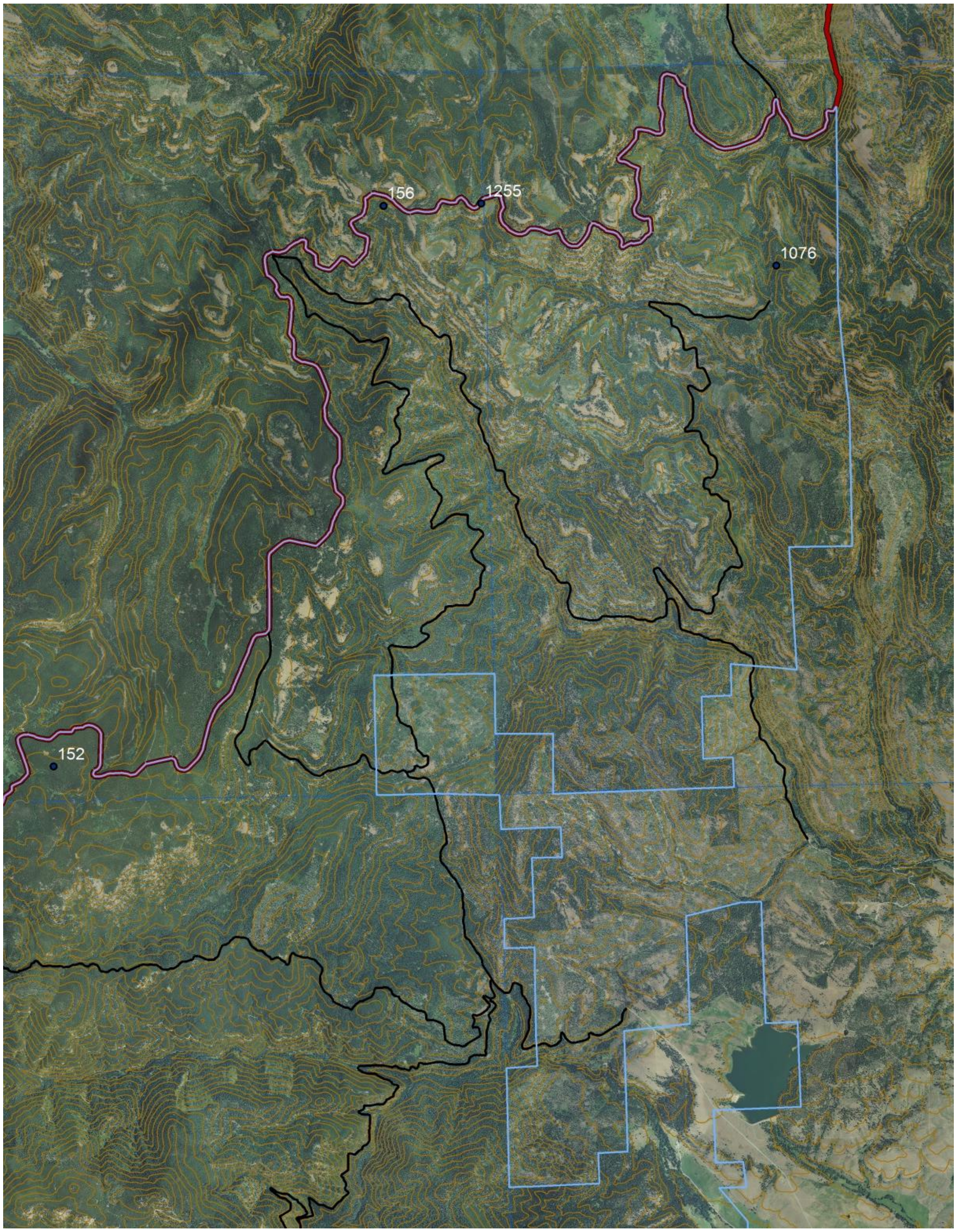

Figure 1: Eastface project area delineated by the 43 road (purple line) and the Forest boundary (blue line). Numbered dots indicate sites visited and referred to in the text.

Western spruce budworm outbreaks have increased in duration and intensity over the past century in conjunction with fire suppression that has allowed budworm host trees to proliferate (Anderson et al. 1987; Swetnam et al. 1995). There is also some evidence that budworm outbreaks in the Blue Mountains may be increasing in frequency from two or three in the 18th and 19th centuries to three or four in the 20th century (Swetnam et al. 1995).

Douglas-fir tussock moth outbreaks are now occurring in areas where they were not known to occur in the past due to stand changes from non-host ponderosa pine to dominance by grand fir and Douglas-fir, most recently on the Heppner Ranger District (see file code 3420, Scott letter dated July 17, 2002). The East Face area is an example of areas that were probably at low risk for budworm and tussock moth in the past due to lack of hosts, lower tree density, and fewer understory hosts. Now it has both overstory and understory hosts and would support these defoliators at high levels.

Some of the overstory western larch is heavily infected with dwarf mistletoe. Dwarf mistletoe is a parasitic plant, and most species only infect one species of host tree. When dwarf mistletoe seeds land on a suitable host tree, the seeds germinate and parasitize the tree by extending an endophytic root system into the vascular tissue of the branch, thus receiving moisture and nutrients from the host. Parasitism causes a host reaction that consists of the production of many host tree meristems resulting in a 'broom', which is a place where an unusual number of host branches originate from the same area. The dwarf mistletoe also produces small mistletoe shoots which bear the male or female flowers. Female plants then produce seeds which are forcibly discharged, often shooting up to 60 feet away from infected trees, although most seeds fall closer (Hawksworth and Wiens, 1996).

Larch dwarf mistletoe (*Arceuthobium laricis*) can cause severe brooming, and loss of foliage when the brittle brooms break out with heavy snow loads. Mistletoe plants in brooms produce a seed rain that falls and infects understory larch near the infested overstory. Schmitt and Hadfield (2009) recommend removing moderately and severely infested (DMR 3-6) trees to avoid infection of the understory and regeneration. Where larch snags are desirable for wildlife use, trees with severe infections (DMR 6) can be retained. These severely infested trees have reduced vigor and smaller crowns, and probably produce fewer dwarf mistletoe plant and seed than moderately infested, more vigorous hosts. Removing all larch regeneration within about 40 feet of infested trees would remove host and therefore preclude intensification and perpetuation of dwarf mistletoe infection in the subsequent stand.

Where western larch overstory is available it provides some opportunities for promoting larch and reestablishing early seral species here. Strategic openings designed to regenerate to western larch, either through natural seeding or planting, but to avoid dwarf mistletoe infection may be effective. Larch is very important as a seed source to reestablish this and stands like it as early seral. The early seral species, larch, ponderosa pine, and in some cases Douglas-fir, are declining here and not reestablishing due to the high density and lack of openings. Where suitable overstory seed sources do not exist, openings will need to be planted with early seral species.

In stands like this, early seral species are at high risk to competition stress due to heavy ingrowth of fir. These stressed species are susceptible to subsequent attack by bark beetles and/or wood borers.

Stand 1255, 45.15000°, -118.00667°, about 5700' elevation, north part of project area

This site varies from a cool-moist to cold-dry upland mixed conifer plant association group that includes subalpine fir. The subalpine fir here is infested with balsam woolly adelgid (*Adelges piceae*). This exotic insect has spread throughout the Blue Mountains since its initial discovery on the Walla Walla Ranger District in 1972. Balsam woolly adelgid (BWA) only affects true fir species and subalpine fir is the most susceptible species in the Blue Mountains. Grand fir and/or white fir are rarely impacted here. BWA causes widespread mortality to subalpine fir. It likely has high years of impact when winter weather is moderate and allows greater overwintering survival and activity (Mitchell and Buffam 2001). Individual trees appear to have varying susceptibility to this insect, with some whole trees turning red in one year with high infestation, others losing foliage or branches over several years before succumbing.

Because this insect is new to our forests, caution must be used where stand manipulations are planned. There is some history of overreaction to new, exotic insect or disease threats in the United States that has resulted in preemptive logging of species at risk. American chestnut in eastern forests was preemptively salvage logged ahead of the chestnut blight infestation (Frothingham 1924), removing trees with possible genetic resistance. The current hemlock woolly adelgid infestation in eastern forests is also resulting in preemptive salvage logging of hemlock where it is believed it will eventually die from infestation (Brooks 2004). There likely exists some individual variability in susceptibility to the adelgids, perhaps in physical resistance for example through bark thickness or in chemical resistance (Mitchell and Buffam 2001). We caution against complete removal and species conversion of stands where subalpine fir can contribute to stand diversity. Since this insect is very new to these forests, trees have not yet had a chance to express any inherent resistance they may have. Partial removals of the most susceptible trees or removals in some stands but not others will be the prudent course to avoid widespread removal of any inherent resistance in existing populations.

Stands should be managed silviculturally to sustain subalpine fir over the long-term where climatic conditions allow. Subalpine fir is known to be an important food source for moose in fall and winter in MT, WY, and BC (Peek 1974). It is used for roosting and believed to be a winter food source for blue grouse (Steele et al. 1981). There is some evidence that drought stress increases trees' susceptibility to BWA damage (Hain 1988). As a component of high elevation forests, subalpine fir is a pioneer species but also very shade-tolerant and thus a climax species. However, where stocking is high, subalpine fir will experience competition-induced drought stress. Reducing stocking to levels recommended by Cochran and others

(1994) and Powell (1999) may provide resistant firs the additional vigor they need to survive BWA infestation. Stand manipulations that increase or maintain species diversity are increasingly important as the likelihood of disturbance events increases with a changing climate.

Douglas-fir has varying levels of dwarf mistletoe in this stand. Douglas-fir dwarf mistletoe (*Arceuthobium douglasii*) has a life cycle similar to other dwarf mistletoes. Brooms in Douglas-fir can be very large, and can break out because they retain ice and snow due to their large mass. Brooms can be excellent wildlife habitat, providing nesting and roosting habitat for a number of species (Parks et. al 1999). Regeneration under infected Douglas-fir overstory often is infected but does not have conspicuous brooms or dwarf mistletoe plants. Plants and brooms form when these trees get more direct sunlight after a thinning or partial removal. Because of these cryptic infections in young trees, removal of understory and regeneration is recommended within about 50 feet of infected overstory, and another tree species should be favored or planted near infected Douglas-fir.

Armillaria root disease is causing mortality in grand fir and lodgepole pine in this stand. Armillaria root disease, caused by the fungus *Armillaria ostoyae*, can be very damaging and is exacerbated by site disturbance. Armillaria displays considerable variability in virulence and occurs commonly as both a saprophyte and pathogen. All conifers are susceptible, although grand fir suffers particularly high rates of mortality from this disease. Western larch, western white pine, and lodgepole mortality from Armillaria root disease is uncommon. Ponderosa pine and Douglas-fir are moderately resistant in our zone but vulnerable when young. Management prescriptions in areas where Armillaria is confirmed or suspected should favor the more tolerant early seral larch, lodgepole, and ponderosa pine. Ground disturbance should be minimized. Compaction and disturbance increase tree susceptibility. It is important to strive for natural regeneration. Planted trees, even of normally resistant species, are much more susceptible to mortality. This is believed due to various stressors on planted trees, including the fact that they invariably do not develop the root system of trees naturally regenerated on site.

Stand 156, 45.15000°, -118.13333°, about 5700’ elevation, north part of project area

This is a cool-moist ABGR/VAME, grand fir/big huckleberry potential vegetation type. The stand is multi-storied with an overstory of western larch, Douglas-fir, lodgepole pine, and grand fir. At least one harvest and some firewood cutting have occurred here in the past. Some of the Douglas-firs here have thin crowns but we were unable to determine a biotic cause. There had been severe soil disturbance in the area of thin crowns, possibly due to skidding or driving stock and resultant soil erosion. While we found no evidence of root disease, the crown symptoms here indicate root problems, likely a result of past ground disturbance.

This stand, like 1076, is a good example of a moist forest progressing from early successional ponderosa pine and larch to dominance by Douglas-fir and grand fir. As fir-dominated stands, they are now at increased risk to defoliator outbreaks and root diseases.

Annosum root disease is becoming more common on many grand fir plant association sites that were historically maintained in nearly pure ponderosa pine by frequent low intensity fires (Schmitt 2001).

Annosum root disease was common throughout the stand as decay on old grand fir stumps, but little mortality was observed. Grand fir is highly susceptible to Annosus root diseases. Annosus root disease, caused by the fungus *Heterobasidion occidentalae*, is common in grand fir forests in the Blue Mountains. This disease is initiated when spores from a conk land on a fresh stump top or basal wound, germinate, and grow into the stump and root system. Adjacent trees can become colonized when live roots contact an infected root in the ground. Colonization can result in growth loss and mortality. Although common, this disease usually does not result in discernable 'root disease centers', but more often causes scattered mortality in a stand. In one study in northeast Oregon, about 90% of true fir stumps were found to be colonized by *H. occidentalae* (= *H. annosum*) 5-9 years after cutting, and the fungus was found at the stump surface of about 30% of natural regeneration. Although infection rate was high, mortality was very low (about 1%) in regeneration surrounding infected stumps. Engelmann spruce, Douglas-fir, and western larch were tolerant of infection and rarely died (Filip et. al 2000, Filip et al. 2006).

To preclude the spread of Annosus root disease, any grand fir stumps greater than 14" diameter should be treated with a boron compound to prevent spore germination and growth. Stumps should be treated as soon as possible after cutting, but certainly within 24 hours. Two commercially available products labelled for this use are Sporax (Wilber-Ellis company) and Cellu-treat (Nisus corporation). Sporax is a granular substance that is applied to stump tops, and Cellu-treat is formulated as a liquid that must be sprayed on stump tops. Where grand fir will be retained, grand fir stumps greater than 14" diameter should be treated with borate to prevent intensification of the disease.

Stand 152, 45.08333°, -118.19167°, about 6000' elevation, near the center of the project area

This is a grand fir/grouse huckleberry site. It is primarily a lodgepole pine stand with 1/6 of the stocking in western larch, ponderosa, and Douglas-fir. There are approximately 3000 acres of this type across the project area. The lodgepole likely came in after the Anthony fire of 1960.

There is a minor occurrence of Atropellis canker in this stand. Infection can result in reduction in wood quality and stem breakage, but significant damage on a stand basis is uncommon. Dense, stagnated pure stands of lodgepole seem to provide conditions favorable for infection (Lightle and Thompson 1973). Thinning to open up the stand while favoring uninfected leave trees would reduce future damage from Atropellis. Very little western gall rust, caused by the fungus *Endocronartium harknesii*, was seen in this stand.

The lodgepole pine here is about 8-12” in diameter and 100 ft^2/acre, currently of the age, size, and density for high susceptibility to mountain pine beetle. A dominant lodgepole pine 11.4 inches in dbh was cored revealing 15 rings in the last inch of radial increment and a radial increment of 0.55 inches for the last 10 rings. Examination of the radial increment further substantiates the severely reduced diameter growth in recent years and the elevated risk to mountain pine beetle at this location.

There is some evidence that thinning lodgepole stands from below to 4 or 5 meter spacing or to 100 trees per acre will reduce susceptibility to mountain pine beetle attack (Amman and Logan 1998; Whitehead and Russo 2005). Thinning immediately alters the microclimate, increasing light intensity, wind and temperature to reduce beetle attack and survival (Amman and Logan 1998). Additionally, there is growing evidence of historical multiage lodgepole pine stands resulting from low- to moderate-severity fires (Keyes et al. 2014; Amoroso et al. 2011). Stand manipulations that increase the structural diversity will promote resilience to the projected increased disturbances with a changing climate.

Climates in the northwest, including the Blue Mountains, have generally been warmer and wetter over the past 100 years than historically (Mote et al. 2014). However the increase in precipitation is small compared to natural variability. Projected temperature increases for the next century are large relative to natural variability (http://nca2014.globalchange.gov/report/regions/northwest; accessed 2/3/2015). This indicates there will probably be increased moisture stress in many areas. Ponderosa pine has wide ecological amplitude and is better suited to survive these stresses than grand fir. Management that lowers stand density to at least within known historical levels will promote the longevity of these resilient species.

Recommendations:

On all sites with dwarf mistletoe, stands should be managed to prevent the proliferation of dwarf mistletoe, with species or stand structure manipulations.

Most moist upland sites should be managed to restore them to early seral species dominance and to promote the continued establishment of early seral species. This will mean reduced tree densities that will also increase resilience to drought, defoliators and fire.

Where grand fir will be managed into the future, stump treatments are recommended. Where subalpine fir is desired in the future, light thinnings may increase resistance to BWA where blowdown is not a major concern.

Lodgepole pine stands can be managed by lowering densities to reduce their susceptibility to beetles, where blowdown is not a concern.

Where Armillaria root disease is causing mortality, species manipulation, natural regeneration, and avoiding soil disturbance are important.

Let us know if there are any questions regarding this report.

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